but the explanations of the methods of determining them are very meagre. Thus, on p. 22 the declination compass is described, and the explanation given for its use is simply that "the telescope is set in the plane of the geographical meridian, and, as the needle sets in the plane of the magnetic meridian, the angle between the telescope, which always lies over 0° to 180° on the circle, and the needle, is the declination." Again, referring to the determination of dip, it is simply stated "that when the instrument is arranged with the circle in the plane of the magnetic meridian, the angle of inclination can be read off on the circle" (p. 26). We fear that very few students would succeed in getting even approximate values with only these brief statements to guide them if the instruments were put into their hands.

One chapter is devoted to "Examples on Formulæ," which will, no doubt, be of great service to students, although the title is rather suggestive of cramming. The examples given are not less numerous than useful, no less than 52 out of 144 pages being devoted to them. Several of the papers set at previous Matriculation, Science and Art, and other examinations are given.

The book is well illustrated throughout, and although it is more of an epitome of the chief laws and experiments than a text-book, it will, no doubt, be of great service to those for whom it is primarily intended.

Heat and Light. By Edward Aveling, D.Sc. (London: Chapman and Hall, 1889.)

THIS is another text-book of the series referred to in the preceding notice, and follows on the same lines. It is characterized by the same bare outline, the explanations of the methods of determining the various data generally including no suggestion whatever as to difficulties and corrections. This is especially noticeable in the account of Joule's classical experiment (p. 26), in which no mention whatever is made of the corrections for loss of heat due to radiation or for the velocity of the weight on falling. The diagram, too, is seriously wrong, since it simply shows a set of vanes revolving in a vessel of water; without the pierced partitions necessary to prevent the rotation of the water, the experiment is, of course, useless.

The chapter on the composition of white light and the spectrum is perhaps the least satisfactory in the book. The merest outline of the subject is given, and there are two or three very obvious slips. On p. 165, for instance, the electric light and the lime-light are quoted as examples of monochromatic light, and again on p. 166 it is stated that "glowing gases yield spectra with *dark* lines." The idea that the actinic rays are confined to the violet part of the spectrum is rather old-fashioned, and is scarcely likely to be credited by a student who may have happened to experiment in the direction of orthochromatic photography.

Like its predecessor, the book contains numerous examples and illustrations.

The Encyclopædia Britannica. Ninth Edition. Index. (Edinburgh: Adam and Charles Black, 1889.)

THE publication of this volume (of 500 pages) marks the completion of one of the greatest literary undertakings of the present age. As to the necessity for an index there can be no doubt, since, as the editor explains, the plan of the "Encyclopædia Britannica" was that subjects rather than words should be dealt with, and that large subjects should be discussed in a connected way, under general headings, so that the book might be used not only for occasional reference, but for systematic study. This plan was adhered to, and the result is that "many things which a reader may wish to understand are explained, not under their own names, but in the course of a larger discussion." In such cases reference must be made to the index; and this is so full and so accurate that no one who may have occasion to consult it will ever have the slightest difficulty in at once finding what he wants. The index has been compiled by Mr. William Cairns, and arranged and revised by the Rev. George M'Arthur, with the assistance of Miss Emily Stevenson and Mr. J. T. Bealby. The volume contains also a complete list of contributors, with a key to the initial letters affixed to the longer articles. A glance over this list, which includes almost all the foremost writers of the day, suffices to explain the high character of the work as a whole.

Blackie's Modern Cyclopædia of Universal Information. Edited by Charles Annandale, M.A., LL.D. Vol. I. (London: Blackie and Son, 1889.)

IT is intended that the work of which this is the opening volume shall serve as "a convenient work of reference for readers of all classes—comprehensive in scope, handy in size, moderate in price, and generally adapted to the needs of the day." Of course no one who may want to obtain a thorough knowledge of any subject will think of seeking for it in such a work as this; but the editor does not place before himself too high an object of ambition when he expresses a hope that the new Cyclopædia may prove useful to persons who have little time for acquiring information from books in general, though they take an interest in many topics lying outside their own pursuits. The present volume deals with words beginning with the letter A, and with many of those beginning with B. The articles are short but clear, and, so far as they go, accurate. Especial attention has been given to matters which are of living interest in our own day, and we are glad to see that many scientific articles have been written or revised by specialists. The volume contains some good maps and many interesting pictorial illustrations.

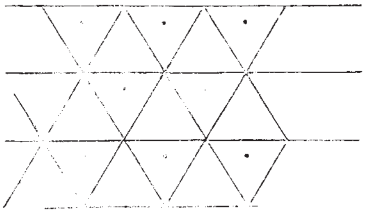
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spherical Eggs.

A BIOLOGICAL friend lately asked me for a solution of the problem, How many spherical eggs, 0·03 millimetre in diameter, can be contained in a cubic millimetre?, the whole space occupied by the eggs being large compared with a millimetre. Assuming the eggs as closely packed as possible in a horizontal stratum, their centres will lie at the angular points of a series of equilateral triangles whose sides are equal to a diameter. The number of spheres in this stratum corresponding to a unit of area will thus, on an average, be $\frac{2}{d^2\sqrt{3}}$, d being the diameter.

The next stratum above will have the centres of the spheres placed so that each is at the vertex of a regular tetrahedron, having alternate equilateral triangles of the lower series as base. Evidently, in a volume of the slice between the two planes of centres, having a unit of area for its base, there will be, on an average, $\frac{2}{d^2\sqrt{3}}$ spheres. But the thickness of the slice is $d\sqrt{\frac{2}{3}}$. Hence, in a unit volume, on an average, there will be $\frac{\sqrt{2}}{d^3}$ spheres, *i.e.* $\sqrt{2}$ times, or about $\frac{7}{5}$, as many as would be contained, assuming their centres at the corners of cubes.



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Possibly some of your readers may have considered this problem, and may be able to suggest some other method of packing the spheres. I do not remember to have met with any discussion of it.
W. STEADMAN ALDIS.

University College, Auckland, New Zealand, February 4

Temperatures in Lake Huron.

SOME very interesting results observed by Commander Boulton, R.N., on the temperature of the waters of the Georgian Bay, the eastern basin of Lake Huron, have been placed by him in my hands. They appear to establish that the waters of the bottom of the bay are colder than the even deeper waters of the rest of the lake.

Lake Huron in its profound depths forms three great basins—the Georgian Bay, defined along its western outline by the bold cliffs of the Niagara limestones, and the central and southern basins, separated by the subaqueous corniferous escarpment which diagonally crosses the lake in a south-eastern direction from the outline of Lake Michigan. Whilst the southern basin has generally a sandy bottom, and is in many parts comparatively shallow, the central basin has a floor chiefly of clay, and includes the deepest portions of the lake.

The surface temperature necessarily varies with the seasons, and with the continuous or fitful nature of the weather for days preceding the observations. Thus on May 11, 1888, when the ice had but recently broken up, the surface water of the Georgian Bay near Owen Sound registered 34° F., whilst at $15\frac{1}{2}$ fathoms the minimum was $34\frac{1}{2}$° F.

Observations will during the coming summer be continued in this and other lakes, but in the meantime the records given hereunder may be taken as preliminary illustrations of the temperature of the waters of the bay. For comparison, some published observations taken in 1860 by the United States engineers in the central and southern basins are also given.

GEORGIAN BAY.

Lat. 45° 6′, *long.* 81° 7′.
July 27, 1888, 8.30 *a.m.*

	° F.
Surface	$60\frac{1}{4}$
10 fathoms	$45\frac{3}{4}$
20 ,, ...	$41\frac{1}{2}$
35 ,, ...	41
66 ,, (bottom)	$39\frac{1}{2}$

Lat. 45° 35′, *long.* 80° 49′.
August 20, 1886, 8 *a.m.*

	° F.
Surface	$59\frac{3}{4}$
31 fathoms (bottom)	$39\frac{1}{2}$

Lat. 45°, *long.* 80° 52′.
August 20, 1886, 12.38 *p.m.*

	° F.
Surface	65
42 fathoms (bottom)	$37\frac{3}{4}$

CENTRAL BASIN.

Lat. 45° 18′, *long.* 82° 23′.
July 30, 8 *a.m.*

	° F.
Surface	52
65 fathoms (bottom)	42

SOUTHERN BASIN.

Lat. 44° 33′, *long.* 82° 54′.
August 5, 10 *a.m.*

	° F.
Surface	58
38 fathoms (bottom)	52

Lat. 43° 46′, *long.* 82° 1′.
June 20, 9 *a.m.*

	° F.
Surface	55
45 fathoms (bottom)	52

On August 20, 1886, the temperature of the surface rose from $59\frac{3}{4}$° F. at 8 a.m., to 62° at 9 a.m.; $63\frac{3}{4}$° at 11.34 a.m., and 65° at 12.38 p.m.

The suggestive explanation of the lower temperature of the Georgian Bay depths is that whilst the more southern and warmer waters of Lake Michigan in their course from the inlet to the outlet do not reach the bay, a considerable portion of the colder waters of Lake Superior find their way into it by the channel north of the Manitoulin Islands. Further, the subaqueous cliffs which block the western side of the bay preclude a free circulation between the deeper waters of the bay and the profound depths of the lake beyond.
A. T. DRUMMOND.

Will Fluctuations in the Volume of the Sea account for Horizontal Marine Beds at High Levels?

IN the interesting article "On the Gradual Rise of the Land in Sweden" (NATURE, March 21, pp. 488-92), Nordenskiöld arrives at the conclusion that the small alterations of the relative level of sea and land which observation proves have taken place in Sweden, are due to movements of the land, not to fluctuations of the sea-level. On the other hand, he contends that the extensive horizontal stretches of marine strata found in many places on the earth's surface at heights measured by thousands of feet above the sea-level indicate fluctuations of level in the sea itself. This is certainly reversing the order of things as believed in by most geologists. It is also suggested that the fluctuations of sea-level are due to alternate increase and decrease of the volume of the sea, arising from gaseous and fluid additions from outer space or loss thereto, the alternate gains and losses balancing one another over long periods.

It is not my object in this communication to discuss the physical possibility of such alterations of the volume of the sea having taken place in this way, but to point out that, even if granted, such rising and falling of the sea-level fails to explain the geological phenomena for which it is invoked. Formations horizontal in one place are disturbed in another. They cannot be divided into two hard and fast stratigraphically dissimilar kinds of marine deposits, the *horizontal* and the *folded*, as is attempted by Nordenskiöld. Even the example quoted by him of the Tertiary strata of Spitzbergen shows this, as it is stated, "Near the west coast they are much disturbed, but further inland they form horizontal strata of sand and clay, &c."

The plains of Russia are, as was shown long ago by Murchison, largely occupied by nearly horizontal strata of undisturbed Silurians, while in the Ural Mountains the same formation is thrown up on end. I venture to pronounce this continuity of horizontal with disturbed deposits an almost universal phenomenon, for where plateaus are capped by horizontal strata, as often happens, these cappings are only the remnants left by denudation.

It is a well-known geological fact that as strata recede from a mountain range they become less and less disturbed and more horizontal. Again, there are no horizontal strata of any extent or thickness that are not riven with faults showing that they have been subjected to upthrow or downthrow as the case may be, and these have to be accounted for as well as the level at which the strata occur. Except in the very newest deposits, strata bear very little relation to the levels at which they are now found. Because strata are often horizontal at high levels it is no indication that they have not been upheaved. The Colorado plateaus may be cited as an instance, and such instances may be multiplied to any extent.

There is, however, another difficulty appertaining to the explanation offered by Nordenskiöld. It is this, the general rise of the sea-level over the whole globe to the extent even of 1000 feet would obliterate an enormous area of land. Where, then, would the sediment come from to form the beds appealed to in proof of the rise of the sea-level? Formations are not arranged concentrically at varying levels or, in other words, stratigraphically contoured, as would be the case were they due to this cause. But there is a final and still greater difficulty to be met. Denudation is year by year reducing the height of the land, and if no compensatory elevation excepting over disturbed areas took place, continents instead of growing as they are supposed by some to do, would long ago have been obliterated, and the earth planed down to a uniform level, so that when periods of "high water" recurred all terrestrial life would be destroyed. This contingency no doubt to some minds will be plain demonstration of the truth of Nordenskiöld's theory.
T. MELLARD READE.

Park Corner, Blundellsands, near Liverpool, March 25.

The Meteorological Conditions of the Aruwhimi Forest Tract.

I CANNOT but think that the true explanation of the rank exuberance of the Aruwhimi forests, so graphically described by Mr. Stanley, or rather of the humid climate that fosters them, is different from that suggested either by the great traveller himself or the writer of the notice in last week's NATURE. The source of the winds that feed the rainfall of this region seems to me a question of secondary importance, but since in equatorial regions, as a rule, easterly winds predominate, I am inclined to think, with the writer of the article, that this source is most probably the Indian Ocean.

If, however, this be so, since in the interval between the coast and the Aruwhimi basin they have to pass over some of the highest mountains in the continent, and reach the latter on a descending slope, they would be comparatively dry winds, more or less analogous to the Alpine *föhn*, were there not other conditions present which more than counterbalance the desiccating influence of the eastern mountains. The first and most

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